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ABSTRACT

This publication contains the three numeracy units of the three levels of Support Materials for Agricultural Training (SMAT) in agricultural production: Level 1 (starting), 2 (continuing), and 3 (completing). The units are designed to help the learner improve his or her numeracy skills needed to deal with agricultural production. SMAT materials can be used by the individual, with a mentor, or in a group or class. An introduction describes how to use the materials, types of activities, and materials needed. Each level contains agriculture-related mathematics activities. Model answers are provided. Topics covered in Level 1 are yield (or production), conversion, consumption, and application rates. Topics covered in Level 2 are cost/benefit analysis, cropping, costing, and whole farm change. The topic covered in Level 3 is collecting information. (YLB)

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ED 431 081

Agricultural Production

Numeracy
Level 1

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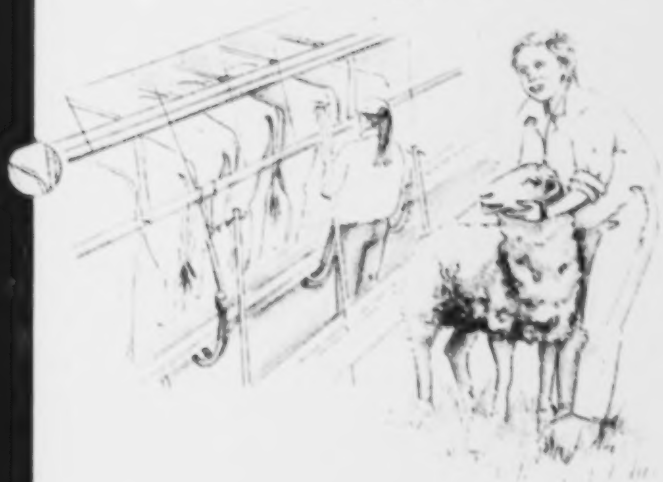

Support Materials for Agricultural Training

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Contents

Introduction 1

- Where this fits 1
- How to use these materials 1
- Outcomes 2
- How long should I spend? 2
- Activities 2
- What you need 3
- Assessment 3

Yield (or production) 4

- Calculating total yield 5
- Average total yield 7
- Is your answer correct? 12
- Average annual production 13

Conversion 17

- Metric conversion 18
- Metric and imperial conversions 28

Consumption 34

- Consumption rates 34
- Daily consumption rates 36
- Amount of feed in a paddock 38
- Pasture usage 39

Application rates 42

- Chemical application rates 42
- Seeding rates 47

Model answers 52

- Activity 1 52
- Activity 2 52
- Activity 3 53
- Activity 4 54

Activity 5	54
Activity 6	54
Activity 7	54
Activity 8	54
Activity 9	55
Activity 10	55
Activity 11	55
Activity 12	56
Activity 13	56
Activity 14	56
Activity 15	56

Introduction

Welcome to this unit of the SMAT materials, *Agricultural Production 1 - Numeracy.*

SMAT stands for Support Materials for Agricultural Training. SMAT will help you improve your written and spoken communication skills and your numeracy skills, so you can succeed at training programs or communicate more successfully in your workplace.

Where this fits

SMAT has four topics: *Agricultural Production, Farmers as Employers, Farm Management and Leadership* and *Occupational Health and Safety.*

This unit is Level 1 of *Agricultural Production - Numeracy.* There are three units of *Agricultural Production - Numeracy*: Level 1 (starting), 2 (continuing) and 3 (completing). Each unit has two parts: Communication Skills and Numeracy.

After you finish this unit, you could try the other units at the same level: *Occupational Health and Safety 1 - Numeracy, Farmers as Employers 1 - Numeracy, Farm Management and Leadership 1 - Numeracy.*

Then you could try the units at a higher level.

You do not have to complete every unit in SMAT. It is up to you to choose the most useful parts and work through them.

How to use these materials

You can use the SMAT materials by yourself, with someone to help you, or in a group or class. It is hard to work by yourself, so it is a good idea to have someone who can give you advice and feedback (a mentor). This person could be a trainer from a college or community centre, a relative, a neighbour or a friend.

The unit is written so you can start at the beginning and work through it. Or if you like you can choose parts of the unit and only do those parts. Spend more time on the parts which are most useful for you. If something is not useful, you can skip it.

There is no certificate to go with the SMAT materials. But SMAT helps you improve your skills so you can do other courses and get other certificates. For example: FarmSmart, Rural Business Management, and courses run by the Department of Natural Resources and Environment. You will also find that working through SMAT improves the communication and numeracy skills that you need in your working life.

Outcomes

After you finish the SMAT materials you will be able to communicate more effectively in speech and writing and use numeracy skills more effectively.

You will also be able to calculate yield, convert imperial and metric measurements, work out consumption of stock and calculate the amount of chemicals you will need.

How long should I spend?

This depends on you. The amount of time will be different if you are working by yourself or in a group, with a mentor or without, and if you do all the activities or not. Take enough time to do all the activities that are relevant to you, to a standard high enough to satisfy you.

Activities

Each unit has a number of activities for you to do. In the communications units there are four types of activities:

- key word activities
- reading activities

- writing activities
- spoken communication activities.

In the numeracy units there are numeracy activities.

Sometimes you can write answers to these activities in the book. Sometimes it is better to write them in a notebook. Sometimes for the spoken communication activities you will need to go and speak to some other people.

In some places there are also practice writing and practice reading activities. These are extra activities. You can choose to do them if you think you want extra practice in something.

Most of the activities have model answers in the back of the book. You can also ask your mentor to check your answers.

What you need

Before you start, make sure you have the following:

- a notebook (A4 size is best)
- pens, pencils, highlighter pens
- a file or folder to keep extra papers.

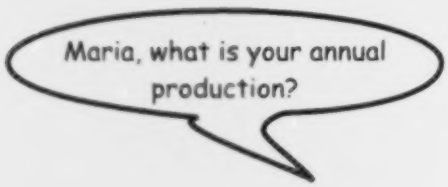
Assessment

There is no formal assessment for SMAT. But it is a good idea to have a mentor look at what you have done. That way you can decide together what you have learned and what you need to improve.

Remember, the SMAT materials are a resource for you to use to improve your skills. It is up to you how you use them and how much of them you use.

Yield (or production)

Maria owns a sheep and crop farm in the Wimmera. She plans to expand her farm by buying the farm next door. She needs a loan from the bank to do this. Part of the information that the bank needs is her past, current and future production (or total yield). The yield (or total production) on a farm is what is grown or produced for selling.



production

total yield	*this is what is grown or produced for selling.*
quantity	*how many of a unit you have*
amount	*how much a unit produces*
predict	*to guess or estimate what the answer will be*
average/mean	*the quantities for each unit divided by the number of units*
annual	*yearly amount of unit produced*

Calculating total yield

The total yield is found by:

Total production or total yield = quantity (How many you have) x **amount** (How much each unit produces)

For example, the wool production for a sheep farm is worked out by multiplying the number of sheep by how much wool each sheep produces in kilograms.

No two sheep will give the same weight of wool so Maria will use a weight that is about the middle weight. Later we will look at finding this figure, called the mean.

Wool Production (or Total Wool Yield) =
number of sheep x kilograms of wool produced per sheep.

Figure 1: Shearer

Activity 1

1. Here are some examples of total yields (production). Choose the right words from the list and fill in the spaces.

milk **hens** **apples** **cows**
wheat **eggs** **hectares**

- Dairy farm:

  Production (or total yield) = number of ..... x litres of ..... per cow.

- Apple orchard:

  Production (or total yield) = hectares x kilograms of ..... per hectare.

- Wheat crop:

  Production (or total yield) = ... x kilograms of ..... per hectare.

- Egg producer:

  Production (or total yield) = number of ..... x number of ..... per hen.

2. What are the products on your farm?

3. How would you find the total yield?

Average total yield

When Maria applied for a loan she was asked what her expected production would be. She will have to predict this.

A farm will not produce the same amount every time. The amount produced is affected by a number of factors. Some of these include:

- the weather
- the amount eaten by an animal
- age of plant/animal
- incidence of disease.

To work out what you expect the total yield or production to be, you calculate the average (or mean).

The average is found by adding the quantities for each *unit* then dividing by the number of units.

To make this clearer, let's look at the total yield or production from Maria's farm.

Maria plants 300 hectares of wheat each year. The following are the total yields for the last 5 years.

Year	Production (tonnes)
1997	845
1996	967
1995	948
1994	816
1993	989
Total	

Think about how could you work out Maria's average wheat production from this information?

Maria finds the average by first finding the total production for 5 years. The total yield is 4565 tonnes. Then she divides this by the number of years which is 5.

On the calculator, key in: 845 + 967 + 948 + 816 + 989 =

The display screen will show: 4565

Then key in: ÷ 5 =

The display screen will show: 913

Maria's average wheat production is 913 tonnes per annum.

Activity 2

Use a calculator to find the averages for each of the following.

1. David and Sue are cereal farmers. They produced the following tonnes of canola for the last 8 years:

   11.61

   32.01

   47.26

   36.14

   27.65

   51.45

   48.43

   48.04

   Total production = ...

   Number of years = ...

   Average = ...

2. Colin Hall shears 750 merino sheep each year. From the kilograms of wool produced over the last 5 years find the average amount of wool per year.

   4650

   4335

   4067

   4758

   3993

   Total production = ...

Number of years = ...

Average = ...

3. Roslyn collected the following number of eggs each day from her free range hens. What is her average daily egg production?

2389

2647

2003

2168

1790

2384

1945

Total production = ...

Number of days = ...

Average = ...

4. Karen grows apples. From the Granny Smith trees the following cases per acre were picked over the last 6 years. What is the average production per year?

2604

1994

2728

2164

2698

2075

Total production = ...

Number of years = ...

Average = ...

5. The number of litres of milk produced each 10 day period on Ken's farm were:

Month	**Period**	**Litres produced**
April	1	2235
	2	7760
	3	16 905
May	1	20 500
	2	25 200
	3	35 280
June	1	34 210
	2	34 890
	3	35 280
	Total	

Find the average amount of milk for a ten day period.

Fill in the spaces with your answers.

Total production =..... litres

Number of 10 day periods = ...

Average = ... litres

6. Choose one product from your farm. Write down the production for each of the last 5 years. What has been the average production per year over the last 5 years?

Is your answer correct?

You can check if the answer looks about right.

The average must be a number between the lowest and highest numbers in your data. In this case between the highest and lowest units of production.

Look in the model answers section to check your answer.

Average annual production

This is the average production collected over a year. Most average production figures are calculated over a year. There are different ways of working out the average annual production.

1. When produce is collected over only one period of the year, like a wheat harvest, then the average yearly production is calculated over a number of years.

2. When produce is collected a number of times in the year, for example egg production, then the average annual yield is found by multiplying the average yield for each collection period by the number of collections in a year.

average annual production = average **production/ collection** x number of collections per year

Let's look at Ken's dairy farm again.

Figure 2: Milking cows

Photo courtesy of Victorian Landcare Magazine

On Ken's farm the average production (or yield) for a 10 day period is 23 580 litres. Ken milks for 9½ months a year. The cows are dry for the rest of the time.

He needs to find out how many 10 day periods there are when he can milk. He uses a calendar.

1997 CALENDAR

	JANUARY					FEBRUARY					MARCH				
Sun.		5	12	19	26		2	9	16	23	30	2	9	16	23
Mon.		6	13	20	27		3	10	17	24	31	3	10	17	24
Tues.		7	14	21	28		4	11	18	25		4	11	18	25
Wed.	1	8	15	22	29		5	12	19	26		5	12	19	26
Thu.	2	9	16	23	30		6	13	20	27		6	13	20	27
Fri.	3	10	17	24	31		7	14	21	28		7	14	21	28
Sat.	4	11	18	25		1	8	15	22		1	8	15	22	29

	APRIL					MAY					JUNE				
Sun.		6	13	20	27		4	11	18	25	1	8	15	22	29
Mon.		7	14	21	28		5	12	19	26	2	9	16	23	30
Tues.	1	8	15	22	29		6	13	20	27	3	10	17	24	
Wed.	2	9	16	23	30		7	14	21	28	4	11	18	25	
Thu.	3	10	17	24		1	8	15	22	29	5	12	19	26	
Fri.	4	11	18	25		2	9	16	23	30	6	13	20	27	
Sat.	5	12	19	26		3	10	17	24	31	7	14	21	28	

	JULY					AUGUST					SEPTEMBER				
Sun.		6	13	20	27	31	3	10	17	24		7	14	21	28
Mon.		7	14	21	28		4	11	18	25	1	8	15	22	29
Tues.	1	8	15	22	29		5	12	19	26	2	9	16	23	30
Wed.	2	9	16	23	30		6	13	20	27	3	10	17	24	
Thu.	3	10	17	24	31		7	14	21	28	4	11	18	25	
Fri.	4	11	18	25		1	8	15	22	29	5	12	19	26	
Sat.	5	12	19	26		2	9	16	23	30	6	13	20	27	

	OCTOBER					NOVEMBER					DECEMBER				
Sun.		5	12	19	26	30	2	9	16	23		7	14	21	28
Mon.		6	13	20	27		3	10	17	24	1	8	15	22	29
Tues.		7	14	21	28		4	11	18	25	2	9	16	23	30
Wed.	1	8	15	22	29		5	12	19	26	3	10	17	24	31
Thu.	2	9	16	23	30		6	13	20	27	4	11	18	25	
Fri.	3	10	17	24	31		7	14	21	28	5	12	19	26	
Sat.	4	11	18	25		1	8	15	22	29	6	13	20	27	

Shading shows time milked

Figure 3: Calendar

He finds that there are approximately 290 days when he can milk in a year.

There will be 29 periods of 10 days in a year.

On the calculator, key in: 290 ÷ 10 =

The display screen will show: 29

Ken finds his average annual yield/production by multiplying his average 10 day yield by 29. He has an average annual yield/production of 683 820 litres of milk.

On the calculator, key in: 23580 x 29 =

The display screen will show: 683820

Activity 3

Find the annual production:

1. Barbara's goats produce 3780 litres of milk per week on average. What is her yearly production? (Work on 52 weeks in a year.)

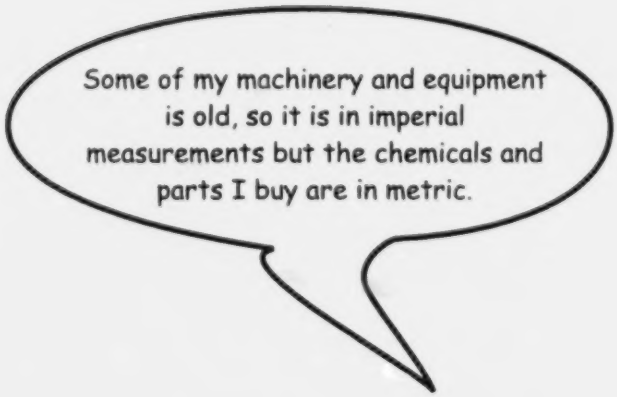
2. Ray collects 2189 eggs on average every day from his hens. Find his average yearly production if his hens lay for 9 months production of the year. (Assume there are 30.5 days a month.)

Conversion

Farmers often need to convert measurements. When you are using metric measures it is necessary to have all the metric measurements in the same units. For example, all centimetres or all metres, not a mixture of the two. More often you need to convert metric to imperial or vice versa.

measurement

metric	*a decimal system of measurement made up of units like the metre, kilogram, ampere, etc.*
imperial	*the British system of weights and measures made up of units like the mile, gallon, pounds, etc.*


Some of my machinery and equipment is old, so it is in imperial measurements but the chemicals and parts I buy are in metric.

Maria often converts a metric measure to a different metric measure or more often, she converts an imperial measure to a metric measure.

Metric conversion

The most common measures are for area, length, weight or liquid volume.

forms of measure

The basic metric units are:

area	*a space like a paddock that is worked out by multiplying length and width*
length	*how long something is*
weight	*how heavy or light something is*
liquid volume	*the amount of space taken up by something in a container. It is calculated by multiplying length, width and height*
litre	*metric measurement for volume*
metre	*metric measurement of length*
gram	*metric measurement of weight*

METRE **LITRE** **GRAM**

These units are made larger or smaller by putting prefixes (or part words) in front of the basic units, for example:

- milli means 1000 (thousand) times smaller or a 1/1000 (thousandth)

- centi means 100 (hundred) times smaller or a 1/100 (hundredth)
- kilo means 1000 (thousand) times larger
- mega means 1 000 000 (million) times larger.

Milli ➨ centi ➨ unit ➨ kilo ➨ mega.

Let's look at length first.

The following table should help you to convert:

1 metre	=	100 centimetres	=	1000 millimetres
1 kilometre	=	1000 metres		

Use the diagram to work out if you need to multiply or divide. Follow the arrows from the unit you are at to the unit you wish to convert to.

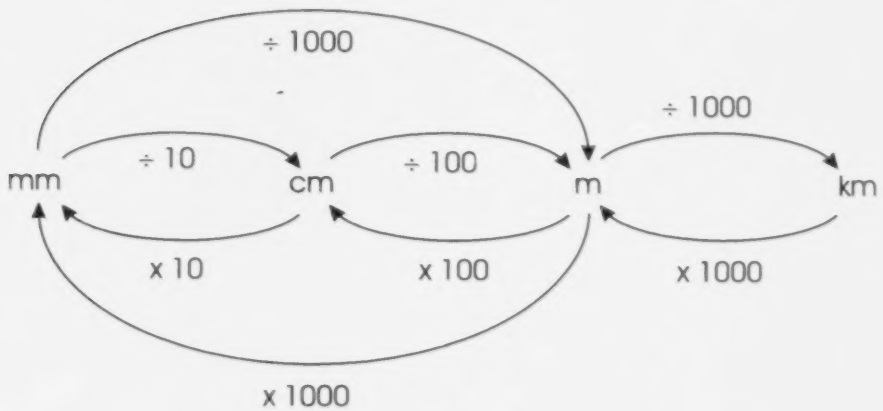


Figure 4: Conversion of length

We will use the diagram to do two examples.

Example 1

A sheep race is 1 metre and 57 centimetres wide. Maria needs to convert this measurement to the one unit.

Figure 5: Maria's sheep

Photo courtesy of Victorian Landcare Magazine

She decides to convert to centimetres. The metre has to be converted to centimetres.

Look at figure 4, going from metres to centimetres you need to multiply by 100. This means 1 metre is 100 centimetres.

On the calculator, key in: 1 x 100 =

The display screen will show 100

Example 2

Altogether the race is 100 + 57 = 157 centimetres.

Michael measured a section of his boundary fence as 5670 metres.

Figure 6: Michael measuring the fence

Photo courtesy of Victorian Landcare Magazine

He needs to convert this measurement into kilometres.

Figure 4 shows that going from metres to kilometres you need to divide by 1000.

On the calculator, key in: 5670 ÷ 1000 =

The display screen will show: 5.67

So, Michael has 5.67 kilometres of boundary in this section.

Activity 4

Use figure 4 to convert these measures:

1. 356 centimetres = ... metres
2. 678 millimetres = ... centimetres
3. 678 millimetres = ... metres
4. 8 kilometres = ... metres
5. 6.9 metres = ... centimetres

In some areas, farms are now numbered by how far they are along the road. The number of David's property is 760. To work out how many kilometres this is along the road, you need to divide the number by 100.

On the calculator, key in : 760 ÷ 100 =

The display screen will show: 7.6

So, David lives 7.6 kilometres along the road.

Activity 5

Use the example above to work out the following answers.

1. Helen's address is 2340 Schultz's Lane. How far along the road does she live?

2. Barry lives 10.4 kilometres along the same road. What would the number of his property be?

There are times when a conversion may be from a very small measurement to a very large measurement such as adding chemicals to a dam or tank.

It is also possible to do a couple of steps at a time. Let's try converting 92 000 millilitres to kilolitres.

The first step is from millilitres to litres.

Step one

For this step following figure 7, you need to divide by 1000.

This becomes 92 000 ÷ 1000 = 92.

Step two

The next step is litres to kilolitres.

You need to divide by 1000 for this step.

92 ÷ 1000 = 0,092.

On the calculator, key in: 92000 ÷ 1000 =

The display screen will show: 92

Then on the calculator key in: ÷ 1000 =

The display screen will show: 0,092

So 92 000 millilitres is 0,092 kilolitres.

Activity 6

Use the steps above to do these conversions:

1. 2546 centimetres = ... kilometres.
2. 8,45 kilometres = ... centimetres
3. 0,678 kilometres = ... millimetres.

You can convert volume and weight in a similar manner using the following conversion table.

1 litre	=	1000 millilitres
1 kilogram	=	1000 grams
1 tonne	=	1000 kilograms
megalitre	=	1000 litres
1 hectare	=	10 000 square metres

When working with metric units it is important to make sure that all the measurements are in the same units.

Maria has 750 grams of dog food left. She buys another 12 kilograms of dog food. How much is there altogether?

It is not possible to add kilograms to grams. You need to convert the grams to kilograms.

From the conversion chart in figure 7, to convert grams to kilograms you need to divide by 1000.

750 ÷ 1000 is 0.75 kilograms.

On the calculator key in: 750 ÷ 1000 =

The display screen will show: 0.75

Then on the calculator, key in: + 12 =

The display screen will show: 12.75

The total kilograms is 12 + 0.75 is 12.75 kg.

The figure below will help you work out if you need to multiply or divide to change volume or weight units.

Follow the arrow from the unit you are at to the unit you wish to convert to.

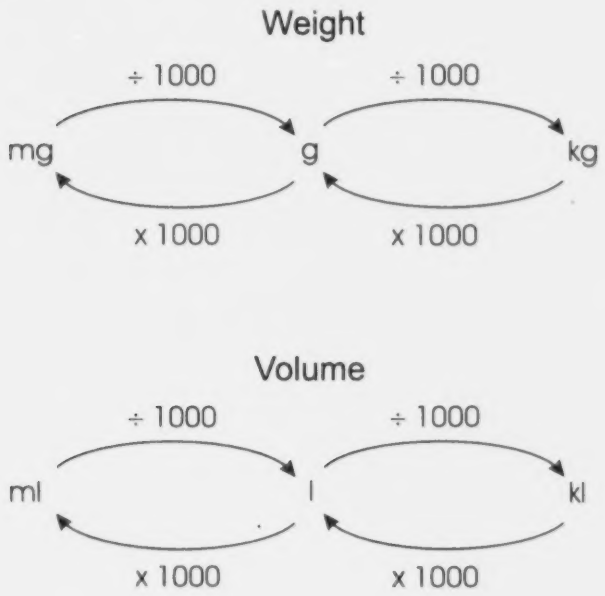


Figure 7: Conversion of weight and volume

Activity 7

Now try these conversions:

1. How many grams are there in 2 kilograms?

2. Your new container holds 5 litres of chemicals. How much is left if you use 400 mL?

3. A farm has 2 104 000 square metres of paddock. How many hectares is this? (1 hectare = 10 000 sq.m.)

4. How many hectares are there on your farm? How many acres is this? (1 hectare = 2.47 acres)

Metric and imperial conversions

Sometimes you need to convert metric measurements to imperial or imperial to metric. For example, older pieces of equipment will be in imperial measurements but the product used with it may be sold with metric application rates.

The following table will help you with metric and imperial conversion.

Let's look at area.

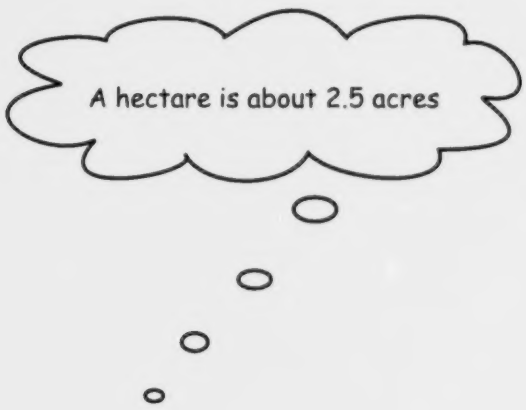
AREA		
hectares	hectares or acres	acres
0.41	1	2.47
0.81	2	4.94
1.21	3	7.41
1.62	4	9.88
2.02	5	12.36
2.43	6	14.83
2.83	7	17.30
3.24	8	19.77
3.64	9	22.24
4.05	10	24.71
8.09	20	49.42
12.14	30	74.13
16.19	40	98.84
20.23	50	123.56
24.28	60	148.27
28.33	70	172.98
32.38	80	197.69
36.42	90	222.40
40.47	100	247.11

Figure 8: Imperial – metric area conversion

If you want to find how many hectares there are in 6 acres, start in the middle column and look up 6. Then move across to the column headed hectares. From this column you get 2.43. So, 6 acres gives 2.43 hectares.

Similarly, if I want to find out what 6 hectares is in acres, then again, I start in the middle column at 6, but this time I read across to the column headed acres. The number is 14.83. So, 6 hectares is 14.83 acres.

You may find it handy to carry some of this around in your head.



Activity 8

Using figure 8, convert the following measurements:

1. 30 acres = ... hectares
2. 8 hectares = ... acres
3. 90 hectares = ...acres

Figure 9 shows conversions for weight, capacity and length.

CONVERSION TABLE								
WEIGHT			VOLUME			LENGTH		
Kilo-grammes	Kg or pounds	pounds	litres	Litres or gallons	gallons	centimetres	Cm or inches	inches
0.45	1	2.20	4.55	1	0.22	2.54	1	0.39
0.91	2	4.41	9.09	2	0.44	5.08	2	0.79
1.36	3	6.61	13.64	3	0.66	7.62	3	1.18
1.81	4	8.82	18.18	4	0.88	10.16	4	1.58
2.27	5	11.02	22.73	5	1.10	12.70	5	1.97
2.72	6	13.23	27.28	6	1.32	15.24	6	2.36
3.18	7	15.43	31.82	7	1.54	17.78	7	2.76
3.63	8	17.64	36.37	8	1.76	20.32	8	3.15
4.08	9	19.84	40.91	9	1.98	22.86	9	3.54
4.54	10	22.05	45.46	10	2.20	25.40	10	3.94
9.07	20	44.09	90.92	20	4.40	50.80	20	7.87
13.61	30	66.14	136.38	30	6.60	76.20	30	11.81
18.14	40	88.19	181.84	40	8.80	101.60	40	15.75
22.68	50	110.23	227.31	50	11.00	127.00	50	19.69
27.22	60	132.28	272.77	60	13.20	162.40	60	23.62
31.75	70	154.32	318.23	70	15.40	177.80	70	27.56
36.29	80	176.37	363.69	80	17.60	203.20	80	31.50
40.82	90	198.41	409.15	90	19.80	228.60	90	35.43
45.36	100	220.46	454.61	100	22.00	254.00	100	39.37

Figure 9: Weight, volume, length conversion table

When reading the table:

1. Find the measure you want to convert, e.g. weight, volume, length.
2. Read down the centre column of the measure to find the amount you want to convert.
3. Read across the row from the amount you know: to the right to find imperial equivalent, or to the left to find the metric equivalent.

e.g.	litres		litres/gallons		gallons
	45.46	←	10	→	2.20
		left		right	

Activity 9

Use figure 9 to convert these measurements.

1.	5 litres	=	…….. gallons
2.	80 kilograms	=	…….. pounds
3.	30 gallons	=	…….. litres
4.	9 inches	=	…….. centimetres
5.	7 centimetres	=	…….. inches
6.	70 pounds	=	…….. kilograms

It is possible to add numbers together to get the right measurement.

For example, Maria is going to grow silage on 73 acres. She needs to know the number of hectares.

There is no conversion for 73 acres in the table. It is possible to make up 73 acres out of 70 acres and 3 acres.

70 acres + 3 acres

28.33 hectares + 1.21 hectares

From the table, 70 acres is 28.33 hectares and 3 acres is 1.21 hectares. Adding the hectares together you get 29.54 hectares.

On the calculator, key in: 28.33 + 1.21 =

The display screen will show: 29.54

Activity 10

Try these metric and imperial conversions:

1. Mario owns a citrus orchard of 240 acres. How many hectares is this?

2. Maria has 47 sheep in a 40 acre paddock. How many hectares is this paddock?

3. A forklift has a lifting limit of 450 kg. How many pounds is this?

4. Fasinex 120 flukicide® for cattle and sheep requires a dose of 60 millilitres (mL) for each animal weighing between 501 and 600 kilograms (kg).

   - How many litres do you need for 100 cattle of that weight?

   - How many gallons is this?

5. List the imperial measurements that you use. Can you convert some of these imperial measurements to metric?

Often, when converting, only an approximation is needed. The following tables give approximate conversion rates.

Imperial to Metric						
1 inch	1 foot	1 yd	1 mile	1 mph	1 oz	1 lb
2.5 cm	30 cm	0.9 m	1.6 km	1.6 km/h	28 g	450 g

Imperial to Metric						
1 ton	1 fluid oz	1 pint	1 gallon	1 acre	1 psi	25 miles/gall
1 tonne	28 ml	600ml	4.5 litres	0.4 hectares	7 kPa	11 L/1100km

Metric to Imperial						
1 mm	1 cm	1 m	1 km	1 km/h	100g	1 kg
0.04 in.	0.4 in	39 in.	0.6 miles	0.6 mph	3.5 oz	2.2 lb

Metric to Imperial						
250 ml	1 litre	1 litre	1 hectare	1 cubic metre	38 °C	4 sq. km
8 fluid oz	1.7 pints	0.2 gall	2.5 acres	35 cubic feet	100 °F	1.5 sq. mile

Figure 10: Approximate conversions

Reproduced with permission from Understanding Farm Chemical Labels. *Published by The Workplace Language Unit, Swinburne University, Melbourne 1996.*

Consumption

To consume means to use something up. So consumption is the amount of something used up. For example, sheep consume grass and grain.

consumption

consumption	*is the amount of something used up*
consumption rate	*how long it takes for something to be used up*
daily consumption rate	*how much is used up in 24 hours*
pasture usage	*how long it will take for avilable pasture to be used up*

Consumption rates

Maria needs to know how long she can leave livestock in a paddock.

To work out the time, Maria will need to know:

- how much grass there is available for her animals
- the size of a paddock
- the number of animals
- how much each animal can eat.

Figure 11: Maria's sheep

Photo courtesy of Victorian Landcare Magazine

Amount of grass

The amount of grass is worked out using a pasture indicator or as many dairy farmers do, by gumboot measures.

A gumboot will not measure the thickness of the grass, only the height. It is okay to use a gumboot for estimating the feed so long as regular checks are made with a pasture indicator.

A pasture indicator gives the amount of available feed in kilograms of dry matter per hectare.

Figure 12: Gumboot measure

Photo courtesy of Victorian Landcare Magazine

Size of paddock

The size of the paddock is in hectares.

Number of animals

This is the number of animals per paddock. More animals in a paddock will eat the feed in a shorter time. Fewer animals can stay in a paddock for longer.

Quantity eaten

Different animals eat a different amount of food per day. For example, dairy cows eat different amounts depending how much milk they produce.

Look at the following table for the dry matter intake.

DM Intake (kg DM/cow/24 hours)	Cows' Production
7.5	dry cow last month of pregnancy
10.5	10 litres milk (4% fat)
13.0	15 litres milk (4% fat)
15.5	20 litres milk (4% fat)
18.0	25 litres milk (4% fat)

Figure 13: Dry matter intake

Daily consumption rates

If you want to know how much will be eaten by your livestock in 24 hours you need to multiply the number of livestock by the dry matter (DM) intake.

DM consumed daily = number of livestock x DM intake

Let's look at Ken's herd of dairy cows. Ken has 750 dairy cows.

Each cow produces 15 litres of milk per day.

Look at figure 13. Under the column headed Cow's Production, find 15 litres. Reading across to the left-hand column, you can see the dry matter intake is 13.0 kg DM/cow/24 hours.

To find the total quantity consumed by Ken's herd you multiply the number in the herd by DM intake.

On the calculator, key in 750 x 13 =

The display screen will show 9750

The herd eats 9750 kg of DM in 24 hours.

Activity 11

Find the daily intake for the following:

1. Hilda has 82 sows on her piggery. Each sow needs 2 kg of feed. How much feed do the sows need a day?

2. Maria has 1500 sheep. Each sheep eats 1.5 kg DM per day. How much will her sheep eat in 24 hours?

3. Gwynne has 230 geese. Each goose needs 1.2 kg of feed each day. How much feed does she need to give her geese each day?

4. Where can you find out how much one animal will eat if you do not know?

5. If you have livestock, can you work out the amount of feed eaten in 24 hours?

Amount of feed in a paddock

A pasture indicator shows the available kilograms of dry matter per hectare (kg DM/ ha). Here is the gauge from a pasture indicator.

HIGH RAIN FALL
Perennial
Pasture

cm RPM	kg dry matter/ha
	3300
11	3050
	2800
9	2550
	2300
7	2050
	1800
5	1550
	1300

Figure 14: Pasture indicator

If the reading you get is 2050, this means that there is 2050 kg of available dry matter per hectare (kg DM/ha).

If the paddock that you measured was 5.6 hectares, how many kg DM is there in the paddock?

To find the answer to this you need to multiply the kg DM by the number of hectares.

In this example, that would be 2050 multiplied by 5.6.

On the calculator, key in: 2050 x 5.6 =

The display screen will show: 11480

There is 11 480 kg available DM in the paddock.

Activity 12

1. Work out the total kg DM for each of the following:

   - 1800 kg DM/ha in a 7.2 hectare paddock.

   .....

   - 3300 kg DM/ha in a 40 hectare paddock.

   .....

2. Choose a paddock that you have livestock on.

   - How many hectares is it?

   .....

   - What kg/available DM is the paddock?

   .....

Pasture usage

How long will the feed in a paddock last?

Let's work with the example from Ken's farm.

Ken wants to know how long his herd will take to eat the feed in the paddock.

He knows that the cows eat 9750 of dry matter in 24 hours. He also knows that there is 11 480 kg available DM in the paddock.

Figure 15: Ken's Cows

Remember that before you do any calculation you need to have an estimate. How long do you think it will take the cows to eat the grass?

- less than a day?
- just over a day?
- about two days?

Ken can find out how long the cows can stay in this paddock by dividing the kg available DM in the paddock by the amount the herd eats.

Consumption time = kg DM/paddock ÷ herd consumption/24 hrs

Ken will divide 11 480 by 9750.

On the calculator, key in: 11480 ÷ 9750 =

The display screen will show : 1.1774358

This means that he can leave the herd in the paddock for just over one day (24 hours).

Activity 13

How long will it take for the following herds to eat the feed in the paddock?

1. Doug put his flock of sheep into a paddock with 112 000 kg available DM in it. The sheep consume 2250 kg DM in 24 hours.

2. Gwynne put her geese into a 30 hectare paddock with 91 500 kg DM in it. Her geese consume 300 kg available DM in 24 hours.

3. Use your answers to Activities 11 and 12 to work out how long your animals will take to eat the feed in the pasture. Use the paddock you chose for Activity 12, Question 2.

Application rates

Maria wants to save money when buying fertilisers and chemicals.

The more she can buy at one time, the cheaper it becomes.

If she works out the amount of fertiliser and chemicals she needs for the year, then she can buy in bulk.

Chemical application rates

Chemical companies supply brochures on the application rates for fertilisers and chemicals. We will look at some of these brochures.

The following is part of a brochure for CALMAX®

CROP RECOMMENDATIONS

CHERRIES/PLUMS

CONDITIONS CONTROLLED	RATE (L/ha)	TIME
Cracking and splitting	4.0-6.0	3-4 applications commencing early fruit stage.

PEACHES/NECTARINES

CONDITIONS CONTROLLED	RATE (L/ha)	TIME
Improved fruit	3.0-5.0	3-4 applications commencing early fruitlet stage.

STRAWBERRIES & OTHER BERRIES

CONDITIONS CONTROLLED	RATE (L/ha)	TIME
Improved fruit firmness	5.0	Apply from the start of flowering and repeat as necessary.

NOTE: It is important that the spray programme continues through to harvest for better control of Bitter Pit. Apply heavier rate when deficiency symptoms are more severe or when crop is more mature.

APPLES

CONDITIONS CONTROLLED	RATE (L/ha)	TIME
Bitter Pit, Water Core and Lenticel Blotch.	4.0-8.0	Apply 4 litres/ha during the Post Blossom/Petal Fall period. Increase rate to 6 litres/ha at the Early Fruitlet stage. Increase rate to 8 litres/ha from the Fruitlet stage to Harvest. Multiple applications at each stage (10-14 days) are required (more frequently when conditions dictate.)

KIWI FRUIT

CONDITIONS CONTROLLED	RATE (L/ha)	TIME
Blossom End Rot	5.0-7.0	Commence spraying at fruitlet stage. Multiple applications (7-10 day intervals) required.

PEARS

CONDITIONS CONTROLLED	RATE (L/ha)	TIME
Firmness Superficial scald	4.0-8.0	Commence spraying at fruitlet stage. Multiple applications (7-10 day intervals) required.

CALMAX ANALYSIS % w/v

NUTRIENT	% ANALYSIS	NUTRIENT	ANALYSIS
Calcium (Ca)	16.00	Iron (Fe)	0.10
Nitrogen (N) as Nitrate	12.85	Boron (B)	0.06
Nitrogen (N) as Urea	0.98	Zinc (Zn)	0.06
Nitrogren (N) as Ammonium	1.17	Molybdenum (Mo)	0.0015
Magnesium (Mg)	1.80	Copper (Cu)	0.03

Figure 16: ***CALMAX® brochure***

Reprinted courtesy of Pivot Agriculture

Think about Karen's apple orchard. The orchard is 56 hectares. How much CALMAX® does she need at different times of the year?

From the crop recommendations for CALMAX® can you find:

- how much needs to be sprayed per hectare?
- how many times it needs to be applied?

Reading the information it tells us that:

- 4 litres per hectare is applied during the post blossom/ petal fall stage
- 6 litres per hectare at the early fruitlet stage
- 8 litres per hectare from the fruitlet stage to harvest
- each stage (10-14 days) needs multiple applications.

From this information we can calculate the amount needed altogether.

Post blossom stage

Karen has 56 hectares of apples. How much CALMAX® should she buy?

Karen needs to apply 4 litres per hectare. As she has 56 hectares, she needs 56 lots of 4 litres or 244 litres.

CALMAX® needs to be sprayed about 12 times during this stage. Therefore, 12 different applications at 244 litres per application gives 2688 litres.

Karen needs to buy 2688 litres of CALMAX® for the post blossom stage.

This calculation can be written as:

Total quantity = amount/ ha x no. hectares x no. of applications

In the above calculation this would be: 4 x 56 x 12

On the calculator, key in: 4 x 56 x 12 =

The display screen would show: 2688

Early fruitlet stage

Using the formula above, the amount of CALMAX® needed during the early fruitlet stage can be worked out.

How much CALMAX® is needed per hectare for the early fruitlet stage?

6 litres per hectare of CALMAX® is needed at the early fruitlet stage.

How many hectares are there?

There are 56 hectares in the apple orchard.

How many applications need to be applied in the early fruitlet stage?

12 applications are recommended during this stage.

So, the number of litres of CALMAX® is worked out by:

6 L/ha x 56 ha x 12 applications.

On the calculator, key in: 6 x 56 x 12 =

The display screen would show: 4032

The early fruitlet stage needs 4032 litres.

Fruitlet to harvest stage

Similarly the amount of CALMAX® needed in this stage is calculated by:

8 x 56 x 12 = 5376 litres.

Karen needs a total of 2688 and 4032 and 5376 litres which is 12 096 litres.

On the calculator, key in: 2688 + 4032 + 5376 =

The display screen will show : 12096

Karen can work out what he needs for the other chemicals and fertilisers for the year using this method. She is then able to buy all his needs at one time.

Activity 14

1. Work out the amount of fertiliser/chemical needed.

   - Faith grows canola in a 13 hectare paddock. She applies nitrogen-sulphur fertiliser before sowing her crop. She needs to apply the fertiliser only once. Nitrogen-sulphur fertiliser is applied at a rate of 166 kg per hectare. How much fertiliser should Faith buy?

   - Nick's citrus orchard needs 500 kg/ha of fertiliser applied. He has 34 hectares of citrus trees. He needs to apply the fertiliser three times. How much fertiliser does he need?

   - Colin applies fertiliser to his pastures twice a year. He applies 225 kilograms per hectare. He has 211 hectares of pasture. How much fertiliser does he use in a year?

2. List the chemical fertilisers you buy?

3. How often do you use them and in what quantities?

.....

.....

.....

.....

4. Fill in the following table using your answers to the last two questions:

Chemical	Amount used each application	Number of times used	Total

Seeding rates

Just as you can work out how much fertiliser you need, you can also work out how much seed you need to sow for every hectare.

The following formula is used to calculate the sowing rate in kilograms per hectare.

$$\frac{\text{Desired number of plants/sq m} \times \text{grain weight of 1000 seeds in grams}}{\text{Germination percentage}}$$

The list below gives the desired plants per square metre.

	Average annual rainfall (mm)		
	250-350	**350-450**	**450-550**
Wheat	150-160	160-190	190-210
Barley	130-160	160-180	160-180
Oats	130-150	150-180	180-200
Triticale	160-180	180-200	200-220
Cereal rye	140-160	160-180	180-200
Canola	50-80	50-80	50-80
Linola	350-400	350-400	350-400
Safflower	25-35	25-35	25-35
Lupins	30-35	35-45	35-45
Lupins (Victoria)	45-60	40-50	35-45
Broad beans	8-12	8-12	8-12
Faba beans, Icarus, Aquadulce	15-20	15-20	20-35
Faba beans, Fiord	20-35	20-35	30-40
Faba beans (Victoria, Icarus)		18-23	
Peas	35-50	40-60	40-60
Peas (Victoria, dwarf var.)	75-95	75-95	75-95
Vetch	40-60	40-60	40-60
Vetch (Victoria, graxing)	50-75	90-100	
Kabuli chickpeas	25-35	25-35	25-35
Desi chickpeas	30-40	35-45	35-45
Desi chickpeas (Victoria)	30-40	40-50	
Lentils (Victoria)	110-120	110-120	110-120

Figure 17: Plants per square metre

Colin wants to sow a crop of wheat. He collects seed from his previous harvest to sow this year's crop.

Colin uses the formula to work out the seeding rate.

Before he can do this he needs some more information. He needs to know the:

- desired number of plants
- grain weight of 1000 seeds
- germination per cent.

From the table he finds the number of plants per square metre (per sq m) is 160 to 190. He uses 175 as it is in the middle of these two numbers.

The following table gives the weight per 1000 seeds of some cereals and pulses.

Grain	Weight g/1000
wheat	35 g
barley	40 g
canola	4 g
oats	32 g
peas	230 g

Colin is planting wheat. Wheat weighs 35 g per 1000 seeds. So one seed will weigh 0.035 g.

Colin knows from past experience that about 90% of the seed will germinate. The percentage must be in decimal form. 90% is 0.9 as a decimal.

The number of kilograms of seed required is found by multiplying 175 plants/sq m by 35g for 1000 seeds, then dividing by 0.9.

On the calculator, key in: 175 x 0.035 ÷ 0.9 =

The display screen will show: 6.805555

We round this number off to the first decimal place. The digit that comes after the first digit (tenths) is a 5, so the 5 in the tenths' column is rounded up to 6.

Colin needs 6.8055 grams of seeds per square metre. This can now be converted to kilograms per hectare.

To convert grams to kilograms we need to divide by 1000, then to convert square metres to hectares we multiply by 10 000.

This calculation can also be done by moving the decimal point.

On the calculator, key in: 6.806 ÷ 1000 x 10000 =

The display screen will show 68.055

Colin needs 68.06 kilograms of seed per hectare.

Activity 15

How much seed does each farmer need?

Use the tables above and the formula to calculate the number of kilograms of seeds per hectare.

1. Ellen lives in an area that has an annual rainfall of 250–350 mm.
   Ellen grows canola. Canola has a germination rate of 95% or 0.95.
   How many kilograms per hectare does she need?

2. Herbert grows peas in an area that has about 380 mm annual rainfall. Peas have a germination rate of 75% (0.75). How many kilograms per hectare should he sow?

3. Julia and Harry grow barley. It has a germination rate of 90%. They live in an area that has 465 mm of rain on average per year. How many kilograms of barley do they need to sow per hectare?

4. Use the table to calculate your seeding rate.

   - What is the annual rainfall in your area?

   - How many kilograms of seed do you need per hectare?

   - What percentage of your seed germinates?

   - How much seed do you need altogether?

Model answers

Activity 1

Question 1

- Dairy

  Production (or total yield) = number of cows x litres of milk per cow.

- Apple orchard

  Production (or total yield) = hectares x kilograms of apples per hectare.

- Wheat farm

  Production (or total yield) = hectares x kilograms of wheat per hectares.

- Egg farm

  Production (or total yield) = number of hens x number of eggs per hens.

Activity 2

Question 1

Total production = 302.59

Number of years = 8

Average = 37.82 tonnes of canola per year.

Question 2

Total production = 21 803

Number of years = 5

Average = 4361 kilograms of wool per year.

Question 3

Total production = 15 326

Number of days = 7

Average = 2189 eggs per day.

Question 4

Total production =14 263

Number of years = 6

Average = 2377 cases of apples per year.

Question 5

Total production = 212 260

Number of ten day periods = 9

Average = 23 584 litres of milk per 10 day period.

Activity 3

Question 1

On the calculator, key in: 3780 x 52 =

The display screen will show: 196560.

Barbara's yearly production will be 196 560 litres of milk.

Question 2

On the calculator, key in: 2189 x 30.5 =

The display screen will show: 66764.5

Then key in: x 9 =

The display screen will show: 600880.5

Ray collects 66 764 eggs a month and 600 880 eggs a year.

Activity 4

1. 356 cm = 3.56 m
2. 678 mm = 67.8 cm
3. 678 mm = 0.678 m
4. 8 km = 8000 m
5. 6.9 m = 690 cm

Activity 5

1. Helen lives 23.4 kilometres from town.
2. Barry's property would be numbered 1040.

Activity 6

1. 2546 cm = .02546 km
2. km = 845 000 cm.
3. 0.678 km = 678 000 mm

Activity 7

1. 2 kg = 2000 g
2. 400 mL is 0.4 of a litre. 5 L - 0.4 L = 4.6 L
3. 2 104 000 square metres = 210.4 hectares

Activity 8

1. 30 acres = 12.14 hectares
2. 8 hectares = 19.77 acres
3. 90 hectares = 222.40 acres

Activity 9

1. 5 litres = 1.10 gallons
2. 80 kilograms = 176.37 pounds
3. 30 gallons = 136.38 litres
4. 9 inches = 22.86 centimetres
5. 7 centimetres = 2.76 inches
6. 70 pounds = 31.75 kilograms

Activity 10

1. 240 acres = 2 lots of 100 acres + 40 acres = 2 x 40.47 + 16.19 = 97.13 hectares
2. 40 acres = 16.19 hectares
3. 450 kg = 4 lots of 100 kg + 50 kg = 4 x 220.46 + 110.23 = 992.07 lbs.
4.
   - For 100 cattle = 60 mL x 100 = 6000 mL = 6 L
   - 6 L =1.32 gal

Activity 11

1. 82 sows x 2 kg = 164 kg feed per day
2. 1500 sheep x 1.5kg = 2250 kg DM /day
3. 230 geese x 1.2 kg = 276 kg of feed per day.
4. You could find out how much one animal will eat from a number of sources including feed suppliers and the Victorian Farmers Federation.

Activity 12

Question 1

- 1800 kg x 7.2 ha = 12 960
- 3300 kg x 40 ha =132 000

Activity 13

Question 1

112 000 ÷ 2250 kg = 49.777.
Doug can leave the sheep in this paddock for about 50 days.

Question 2

91 500 ÷ 300 kg = 305.
Gwynne can leave her geese in this paddock for 305 days.

Activity 14

Question 1

- 166 kg/ha x 13 ha = 2 158 kg of fertiliser.
- 500 kg/ha x 34 ha x 3 applications = 51 000 kg of fertiliser.
- 225 kg/ha x 211 ha x 2 applications = 94 950 kg of fertiliser.

Activity 15

Question 1

Ellen needs to sow:

65 x 0.004 ÷ 0.95 = 0.2737 kg of seed per sq. m. which = 2.74 kg per ha.

Question 2

Herbert needs to sow:

50 x 0.23 ÷ 0.75 = 15.333 g of seed per sq. m. which = 153.33 kg per ha.

Question 3

Julia and Harry need to sow:

170 x 0.04 ÷ 0.9 = 7.556 g of seed per sq. m. which = 75.56 kg per ha.

Agricultural Production

Numeracy
Level 2

Support Materials for Agricultural Training

Acknowledgments

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Contents

Introduction 1

- Where this fits 1
- How to use these materials 1
- Outcomes 2
- How long should I spend? 2
- Activities 2
- What you need 3
- Assessment 3

Cost/benefit analysis 4

Cropping 6

- Drainage 8
- Improving soil 9

Costing 11

Whole farm change 14

- Costs 16
- Increasing feed 17
- Extra feed 18
- Increase in grain 19
- Increase in fertiliser 20
- Additional costs 21
- Analysis 22

Model answers 23

- Activity 1 23
- Activity 2 23
- Activity 3 24
- Activity 4 24
- Activity 5 25
- Activity 6 25
- Activity 7 26
- Activity 8 26
- Activity 9 28

Introduction

Welcome to this unit of the SMAT materials, *Agricultural Production 2 - Numeracy.*

SMAT stands for Support Materials for Agricultural Training. SMAT will help you improve your written and spoken communication skills and your numeracy skills, so you can succeed at training programs or communicate more successfully in your workplace.

Where this fits

SMAT has four topics: *Agricultural Production, Farmers as Employers, Farm Management and Leadership* and *Occupational Health and Safety.*

This unit is Level 2 of *Agricultural Production – Numeracy.* There are three units of *Agricultural Production – Numeracy: Level 1* (starting), *2* (continuing) and *3* (completing). Each unit has two parts: Communication Skills and Numeracy.

After you finish this unit, you could try the other units at the same level: *Occupational Health and Safety 2 - Numeracy, Farmers as Employers 2 - Numeracy, Farm Management and Leadership 2 - Numeracy.*

Then you could try the units at a higher level.

You do not have to complete every unit in SMAT. It is up to you to choose the most useful parts and work through them.

How to use these materials

You can use the SMAT materials by yourself, with someone to help you, or in a group or class. It is hard to work by yourself, so it is a good idea to have someone who can give you advice and feedback (a mentor). This person could be a trainer from a college or community centre, a relative, a neighbour or a friend.

The unit is written so you can start at the beginning and work through it. Or if you like you can choose parts of the unit and only do those parts. Spend more time on the parts which are most useful for you. If something is not useful, you can skip it.

There is no certificate to go with the SMAT materials. But SMAT helps you improve your skills so you can do other courses and get other certificates. For example: Farm$mart, Rural Business Management, and courses run by the Department of Natural Resources and Environment. You will also find that working through SMAT improves the communication and numeracy skills that you need in your working life.

Outcomes

After you finish the SMAT materials you will be able to communicate more effectively in speech and writing and use numeracy skills more effectively. You will be able to interpret more complex graphical data and calculate a simple cost-benefit analysis.

How long should I spend?

This depends on you. The amount of time will be different if you are working by yourself or in a group, with a mentor or without, and if you do all the activities or not. Take enough time to do all the activities that are relevant to you, to a standard high enough to satisfy you.

Activities

Each unit has a number of activities for you to do. In the communications units there are four types of activities:

- key word activities
- reading activities
- writing activities
- spoken communication activities.

In the numeracy units there are numeracy activities.

Sometimes you can write answers to these activities in the book. Sometimes it is better to write them in a notebook. Sometimes for the spoken communication activities you will need to go and speak to some other people.

In some places there are also practice writing and practice reading activities. These are extra activities. You can choose to do them if you think you want extra practice in something.

Most of the activities have model answers in the back of the book. You can also ask your mentor to check your answers.

What you need

Before you start, make sure you have the following:

- a notebook (A4 size is best)
- pens, pencils, highlighter pens
- a file or folder to keep extra papers.

Assessment

There is no formal assessment for SMAT. But it is a good idea to have a mentor look at what you have done. That way you can decide together what you have learned and what you need to improve.

Remember, the SMAT materials are a resource for you to use to improve your skills. It is up to you how you use them and how much of them you use.

Cost/benefit analysis

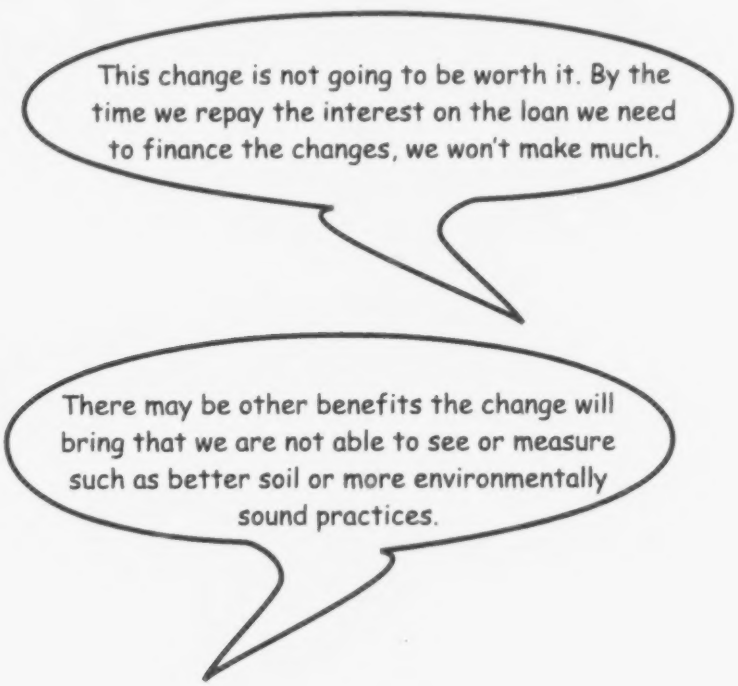
Careful farm planning can increase yield or annual production and may increase profit. To increase your yield it is often necessary to spend more during production. It is important to know when this spending is greater than or exceeds the extra income you will receive from the increased yield. A cost/benefit analysis should be done before changing your farming practices.

To do a cost/benefit analysis you need to:

- list the expected costs involved,
- estimate the income from the increase in yield,
- compare the cost to the expected increase in income,

If the cost is greater than the increase in income then it is not worth changing your farm practices.

Can you think of other examples when the change may have little or no benefit? Sometimes the number of years it takes to get back the initial costs and start to show a profit can be unrealistic.


This change is not going to be worth it. By the time we repay the interest on the loan we need to finance the changes, we won't make much.
There may be other benefits the change will bring that we are not able to see or measure such as better soil or more environmentally sound practices.

Some changes may be small such as increasing:

- the feed given to animals
- amount of fertiliser put on crops.

Other changes may be whole farm changes such as:

- increasing the number of livestock per hectare
- changing to stubble retention or minimum tillage cropping.

We are going to look at examples of a small change and a whole farm change.

Cropping

Ros and Barry have a sheep and crop farm in south west Victoria. They have trouble with drainage because the soil is clay based. The soil structure affects the yield or annual production.

Activity 1

Look at the following graph. Read the questions and answer them in the space provided.

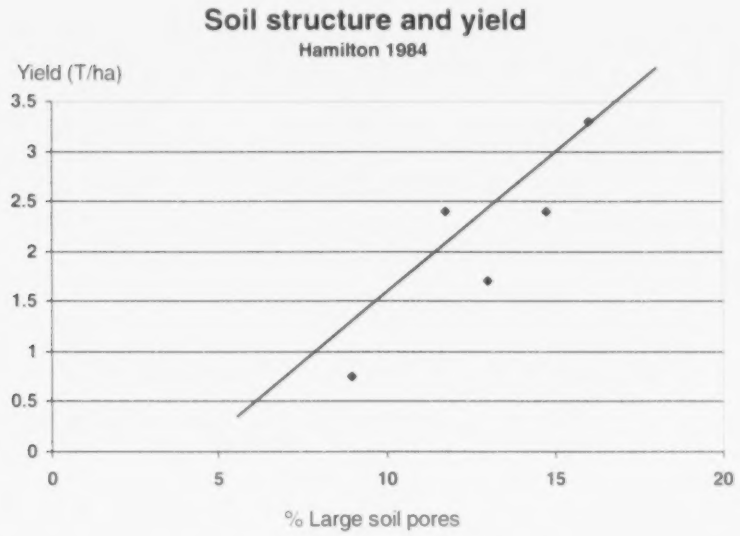


Figure 1: Soil structure and yield.

Reading Graphs

In *Occupational Health and Safety 1 - Numeracy* we looked at how to read pie charts. Reading any graph follows the same rules.

Remember when you interpret data on a graph to:

- Look at the graph's title to find out what the graph is about.

- Look at the name of the axes (or labels) or key/legend to find out what data is being shown.
- Look for any patterns, similarities or differences.

1. What does this graph show you?

2. What percentage of large soil pores do you need to achieve a yield of 3.5 tonnes per hectare?

3. At about what percentage do you get less than one tonne per hectare?

4. What are large soil pores?

5. Why can't you have 100% large soil pores?

6. Do you think there is a maximum percentage of large soil pores that you can have and that anything greater will cause different problems?

7. What might the problems be?

8. What would lack of water in the soil do?

9. Do you know what can be done to increase the percentage of large soil pores?

Drainage

Large soil pores let the water drain away between rainy periods. What problems will occur if the water doesn't drain away? If the water pools on the surface, the roots of the crop will not be able to breathe.

Ros and Barry try to use level, well drained paddocks for planting crops but do not have enough paddocks that are like this. They need to use some poorer grade paddocks.

Activity 2

Ros and Barry know the paddocks that don't drain well and produce a lower yield (annual production). Look at the following graph. Answer the questions.

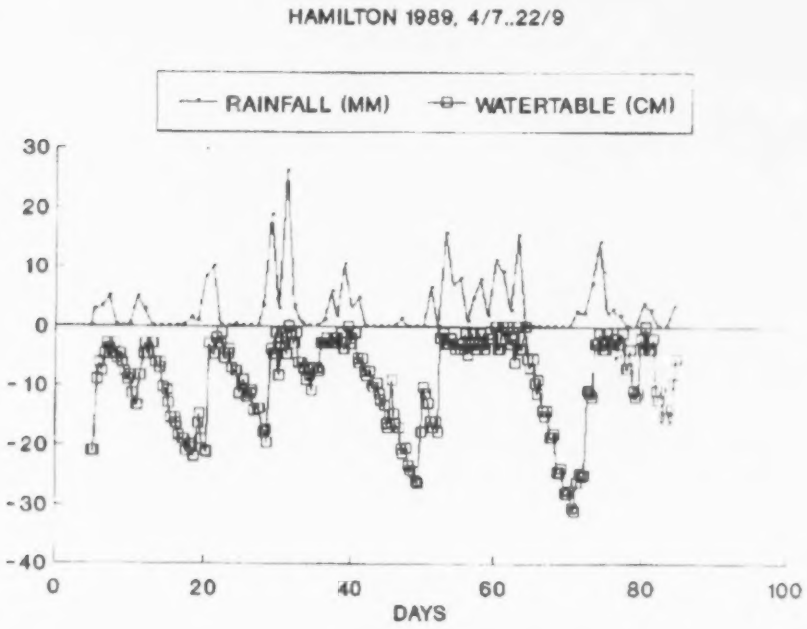


Figure 2: Hamilton water table

Reproduced with permission from Victorian Farmers Federation Grains Group

1. What does this graph show?

.....

2. What connection can you make between high rainfall and the depth of the watertable below the surface?

.....

3. What happens to the watertable when there are a number of days close together in which rain falls?

.....

4. Can you tell from the graph how quickly the water drains after rain?

.....

5. Is it possible to state whether the soil drains well or not?

.....

6. What other information or graphs would you need to see to decide if the soil is draining well?

.....

Improving soil

The better the soil, the faster the water will drain away from the crops and the healthier the roots will be. It is important that the water doesn't drain off too quickly. What problems could this cause?

Lack of water retention will mean that the crops will not get enough water and will produce less or wither. How can you improve the drainage of the soil?

The following is a list of the strategies that can be used to improve drainage:

- minimise tillage
- use gypsum on soils that are chemically unstable
- put in drainage.

74

Ros and Barry have used the first two methods and find that they still have a problem with drainage. They decide to put down drainage to cut down on or get rid of the waterlogging problem. First they do a cost/benefit analysis to see if the drainage will pay for itself.

Activity 3

What costs will they have? Make a list of the costs you think there are in putting in drainage.

Compare your list to Ros and Barry's in the model answers.

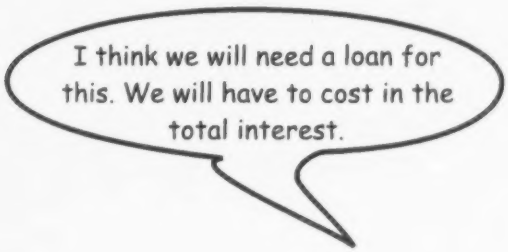
Costing

Ros and Barry find that the cost of drainage varies and depends on:

- how close together the pipes are
- if the drainage from the paddock can be directed into a creek bed close by
- if run off drains have to be built.

Barry and Ros decide to drain 80 hectares that can be drained into a creek. They choose to have the pipes close together to get better drainage. The quote they receive is $1200 per hectare.

They find the total cost for 80 hectares to be $96 000.



Next, they estimate the yield (or production) and the profit increase if drainage is put in. They use the following table to help with this.

Yield of triticale and lucerne (1986/87) and wheat (1987/88) on drained and undrained land at Hamilton

Yield (t/ha)	Triticale	Lucerne	Wheat
drained	4.6	5.6	4.0
undrained	1.7	2.4	1.4

Reproduced with permission from Victorian Farmers Federation Grains Group

Ros and Barry plan to plant 20 hectares of triticale and 60 hectares of wheat on the drained paddocks.

Activity 4

1. Use the information above to fill in the following table for paddocks that are undrained. The first one has been done for you. Put in the total amount earned.

Crop	Ha	Yield/ha	Total yield	$/t	Total $
wheat	60	1.4 t/ha	60 x 1.4 = 84t	$139*	84 x 139 = $11 676
triticale				$138*	
					$

* prices from Wimmera Gross Margins 1997-1998 - FarmSmart

2. Recalculate the total income using the yield for paddocks that are drained. The first one has been done for you.

Crop	Ha	Yield/ha	Total yield	$/t	Total $
wheat	60	4.0 t/ha	60 x 4.0 = 240 t	$139*	240 x 139 = $33 360
triticale				$138*	
					$

* prices from Wimmera Gross Margins 1997-1998 - FarmSmart

3. How much more income would Ros and Barry earn if they drained their paddocks?

.....

.....

4. How many years will it take for them to recoup the costs of putting in drainage?

5. Do you think this is a change worth investing in?

Whole farm change

Sometimes a change involves the whole farm. We are going to study a dairy farm that plans to increase the number of cows per hectare. This change will take place over a number of years as it involves some investment in equipment and an increase in workers.

Figure 3: Vin's herd

Vin currently owns a 120 ha dairy farm on which he has 170 cows. He plans overtime to increase the number of cows to 490.

Activity 5

Vin increases the litres of milk and the sales of cows with the increase in stocking rate. If each cow currently produces an average of 237 kilograms of butter fat per year then:

1. How many kilograms of butterfat a year are Vin's cows producing?

2. If band 2 butterfat sells for $1.96 per kilogram, how much income will Vin make?

3. How many kilograms of butterfat a year will be produced on Vin's farm if he increases the number of cows to 490?

4. What will be the increase in income from the increase in production?

5. Vin will also sell more stock each year with the increase in stocking rates.

   Livestock sales over the past 3 years have been:

   $9112, $22 032 and $21 760

   What is the average income from livestock sales?

6. Vin predicts that the average income from livestock sales with an increased herd will be $526 200.

   What is the increase in income from livestock sales per year?

   .....

   .....

7. What is the total increase in income from both livestock and butterfat?

   .....

   .....

Costs

An increase in herd size will mean a number of changes to the farm. Vin makes a list of the changes that will need to be put into action.

- employing full-time labour
- building more tracks
- constructing effluent ponds
- investing in a rotary dairy
- improving the water supply
- agistment costs.

Vin's current costs will also increase. He will have an increase in feed, fertiliser, breeding, animal health, electricity and vehicle costs to name a few.

Increasing feed

Let's look at the increase in feed costs. Vin needs to supply more feed when he increases his stock rate.

Activity 6

Vin needs to work out how much feed he needs per cow per day.

The following table gives the dry matter intake of cows:

DM intake (kg DM/cow/24hrs)	Cow's production
7.5	dry
10.5	10 litres of milk
13.0	15 litres of milk
15.5	20 litres of milk
18.0	25 litres of milk

Note: These calculations are based on all feed being consumed from a paddock, not the available dry matter.

Vin aims for 20 litres of milk per day per cow.

1. How much will he need to feed one cow to achieve this?

2. How many kilograms of dry matter a day will he need for his current herd?

3. How many kilograms of dry matter a day will he need to fed the larger herd?

4. Vin's paddocks produce 7 tonnes of dry matter per hectare per year. How many kilograms of dry matter does he grow altogether?

   *Remember that Vin's farm is 120 ha.

5. How many extra kilograms of dry matter does he need to feed his current herd?

6. How many extra kilograms of dry matter will he need to feed the increased herd?

Extra feed

Fodder in the pastures alone will not feed the cows. Vin has in the past supplemented the feed with grain. With the larger herd size, Vin will use a number of methods to increase the feed rates. He will:

- increase the amount of grain fed out
- plant a summer crop
- optimise grazing rotations
- increase the amount of fertiliser used
- agist out the young calves.

Increase in grain

Vin feeds more grain to the cows than he needs to because he wants to save some pasture and allow for the larger herd size after calving. He calculates that he needs 297 kilograms of grain per cow per year. When he increases the herd size, he will need 1166 kilograms per cow.

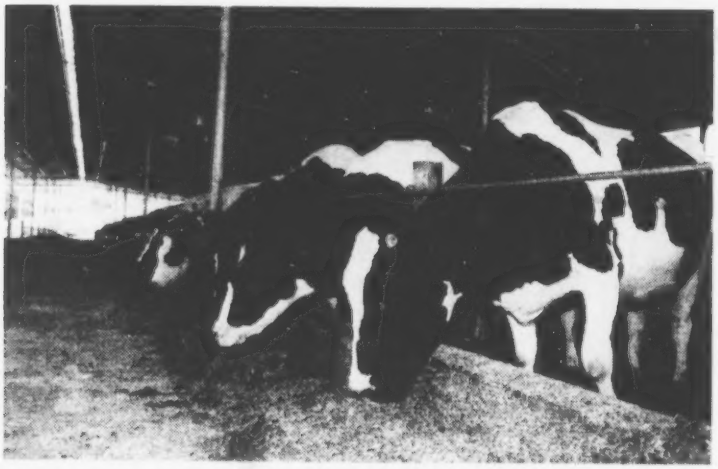


Figure 4: Grain supplement feeding

Photo courtesy of Victorian Landcare Magazine

Activity 7

1. How many kilograms of grain does Vin need a year to feed his current herd?

2. How many kilograms of grain will be needed for the larger herd? How much extra grain is this compared with the current herd?

3. If grain costs $220 per tonne, how much will the grain for a year cost for the current herd?

.....

.....

4. What is the increase in cost of grain feeding for the increased herd?

.....

.....

Increase in fertiliser

To make the best of the growth in fodder, Vin will need to carefully manage a fertiliser program. At the moment he adds a booster to his paddocks each October to encourage growth. He plans to fertilise each paddock after it has been grazed, mainly with Urea.

Activity 8

The following table shows how much fertiliser is needed for both the current farm and for the increased productivity farm.

Current farm	Increased productivity farm
hay booster 250 kg/ha	Urea 100 kg/ha by 6 applications
	DAP 125 kg/ha
	Hay booster 300 kg/ha
	Potash 215 kg/ha
	Superphosphate 400 kg/ha

1. What is the total kilograms of hay booster need for the current farm?

2. How many kilograms of fertiliser in total is needed on the increased productivity farm?

3. If Urea costs $463 per tonne, superphosphate costs $342 per tonne, DAP costs $476 per tonne, potash costs $124 per tonne and hay booster costs $203 per tonne, calculate the total amount currently spent on fertiliser by Vin and the cost of fertiliser for when the herd increases.

4. How much more will Vin spend on fertiliser a year?

Additional costs

Vin will plant a crop of turnips each year to help feed the additional cows. He will also agist out the young stock so that they do not eat fodder that is being grown for future feed. Also paddocks that were previously used to feed young stock are now used for crops.

Agistment will cost Vin $57 800. The growing of turnips will cost Vin $628 per hectare sown. Vin plants 13 hectares of turnips. The total costs for sowing turnips is $8164.

Activity 9

1. Write the costs of feeding the cows for Vin's current farm and for the extra stock into the table then find a total for both.

Food source	Current farm	Increased productivity farm
grain		
fertiliser		
agistment		
crops		
TOTAL		

2. How much more does it cost to cover feed for the increase in herd size?

Analysis

There are many more changes that Vin would need to make to increase the herd size. He would need to do a cost benefit analysis on all the changes he proposes. The changes would be made over a period of time, not all at once. Changes of this size should not be done without expert help and detailed study. A detailed study of this proposed change can be obtained from the Department of Natural Resources and Environment, Ellinbank.

Model answers

Activity 1

1. This graph compares the percentage of large soil pores to the yield in tonnes per hectare, in the Hamilton region.
2. You need approximately 17% of large soil pores to achieve a yield of 3.5 tonnes per hectare.
3. Less than 9% large soil pores will yield less than a tonne per hectare.
4. Large soil pores are the holes in the soil structure.
5. 100% large soil pores would mean all holes and no soil.
6. If there are too many large soil pores, the water will drain away too quickly and the crops will not receive enough water.

Activity 2

1. This graph shows the depth of the water table below the ground and the amount of rain in millimetres over the period of time from 4th of July to 22nd of September at Hamilton.
2. The higher the rainfall, the closer to the surface the water table is.
3. A number of days of rain in a short period of time means that the water table will remain close to the surface. The water is not able to drain away.
4. The graph shows how many days it takes for the water to drain away.
5. It is not possible to state whether the soil drains well or not from the graph. There would need to be a number of graphs of different soil types in the same area to be able to make comparisons.

Activity 3

Some of the costs involved in installing drainage are:

- hire of digging equipment
- drain pipes and other parts
- labour.

Activity 4

1.

Crop	Ha	Yield/ha	Total yield	$/t	Total $
wheat	60	1.4 t/ha	60 x 1.4 = 84t	$139*	84 x 139 = $11 676
triticale	20	1.7 t/ha	20 x 1.7 = 34t	$138*	34 x 138 =$4692
					$16 368

2.

Crop	Ha	Yield/ha	Total yield	$/t	Total $
wheat	60	4.0 t/ha	60 x 4.0 = 240 t	$139*	240 x 139 = $33 360
triticale	20	4.6 t/ha	20 x 4.6 = 92t	$138*	92 x 138 =$12 696
					$46 056

3. With drainage the crops will earn $29 688 more.
4. It will take just over 3 years to recoup the cost of drainage.

Activity 5

1. Vin's cows will produce 40 290 kilograms of butter fat per year.
2. The income will be $7896.84
3. The increased herd will produce 116 130 kilograms of butter fat per year.
4. The income will be $227 614.80
5. Average livestock sales are $17 634.67
6. The increase in livestock sales is $8565.33
7. The total increase in income is $475 147.23

Activity 6

1. Each cow needs 15.5 kg of dry matter per day.
2. Total feed for one day is 15.5 x 170 = 2635 kg dry matter (DM).
3. For the increased herd the feed for one day is 15.5 x 490 = 7595 kg of dry matter.
4. Total dry matter grown is 7 x 120 = 840 tonnes.
5. Current herd needs 2635 kg DM x 365 days – 1000 = 962 tonnes per year.
6. This is 122 tonnes more than is grown.
7. The increase herd needs 7595 kg DM x 365 – 1000 = 2772 t DM per year.
8. This is 1932 kg DM more than is grown.

Activity 7

1. 297 x 170 = 50 490 kg of grain per year

2. 1166 x 490 = 571 340 kg of grain per year.

   This is 520 850 kg extra.

3. Grain will cost:

   50.49t x $220 = $11 107.80 for the current herd

4. For the increased herd,

   571.34t x $220 = $125 694.80.

   This is $114 587 extra.

Activity 8

1. Total kilograms of hay booster need is 250 kg x 120 ha = 30 000 kg or 30 tonnes.

2. Total kilograms of fertiliser needed to increase farm productivity is:

   - Urea

     100 x 6 x 120 = 72 000 kg or 72 tonnes

   - DAP

     125 x 120 = 15 000 kg or 15t

   - Hay booster

     300 x 120 = 36 000kg or 36t

   - Potash

     215 x 120 = 25 800 kg or 25.8t

   - Superphosphate

     400 x 120 = 48 000 or 48t

     Current total amount of fertiliser is therefore 196 800kg or 196.8t

3. Cost for current farm:

   - 30 tonnes x $203 = $6090

   Cost for increased farm:

   Urea

   72t x $463 = $33 336

   DAP

   15t x $476 = $7140

   Hay booster

   36t x $203 = $7308

   Potash

   25.8t x $124 = $3199.20

   Superphosphate

   48t x $342 = $16 416

   $33 336 + $7140 + $7308 + $3199.20 = $67 399.20

4. This is $61 309.20 more.

Activity 9

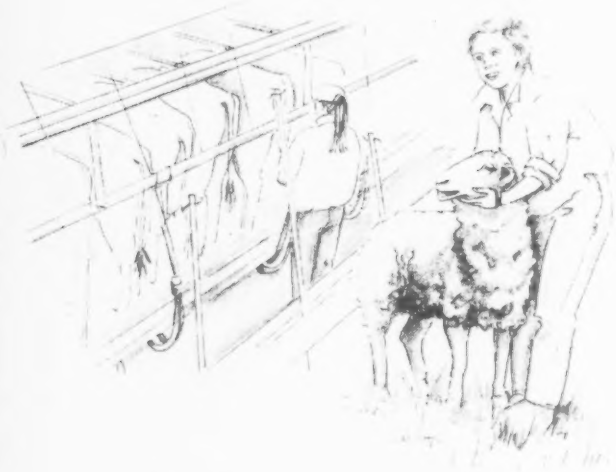
1.

Food source	Current farm	Increased productivity farm
grain	$11 107.80	$125 694.80
fertiliser	$6 090	$67 399.20
agistment	$0	$57 800
crops	$0	$8 164
TOTAL	$17 197.80	$259 058

2. The extra cost to cover feed for the increased herd is:
$259 058 - $17 197.80 = $241 860.20

Agricultural Production

Numeracy
Level 3



Support Materials for Agricultural Training

Acknowledgments

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Contents

Introduction **1**

Where this fits 1
How to use these materials 1
Outcomes 2
How long should I spend? 2
Activities 2
What you need 3
Assessment 3

Collecting information **4**

Graphing information 4
Moving averages 7
Evaluating data 8
Calculating the moving average 9
Moving averages in irregular periods 12

Model answers **17**

Activity 1 17
Activity 2 17
Activity 3 17
Activity 4 18
Activity 5 20

Introduction

Welcome to this unit of the SMAT materials, *Agricultural Production 3 - Numeracy.*

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- a file or folder to keep extra papers.

Assessment

There is no formal assessment for SMAT. But it is a good idea to have a mentor look at what you have done. That way you can decide together what you have learned and what you need to improve.

Remember, the SMAT materials are a resource for you to use to improve your skills. It is up to you how you use them and how much of them you use.

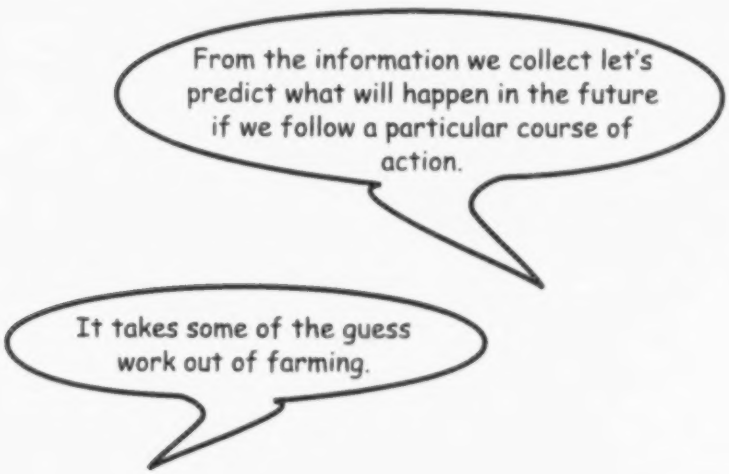
Collecting information

In *Occupational Health and Safety 1 and 2*, we looked at how information (data) that had been collected was graphed. From the graphs it was then possible to be able to get a quick visual picture of the data.

In this unit we are going to look in more detail at the data that is collected. What happens if the data is too erratic to show anything of value? There are statistical tools we can use to improve the presentation of the data.

Graphing information

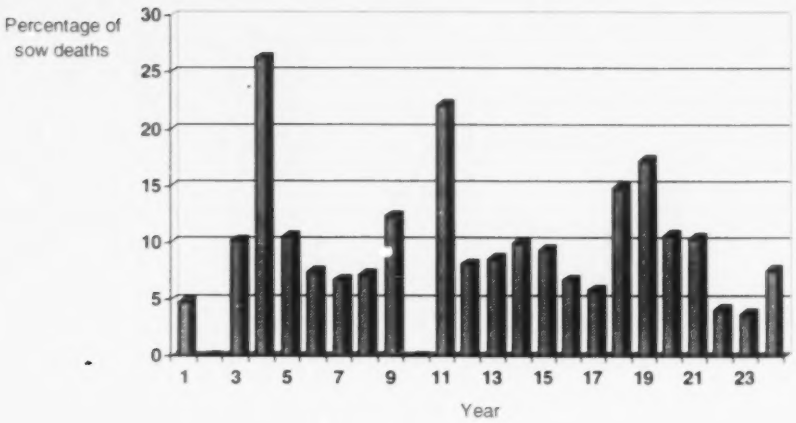
Ian and Joe operate a pig farm. They constantly collect data from the farm. They use this data to help them improve their management practices. If they can predict the number of deaths, the average weight of the pigs and how much each pig will need in feed, they can then plan ahead.


From the information we collect let's predict what will happen in the future if we follow a particular course of action.
It takes some of the guess work out of farming.

In the following chart they have recorded the percentage of sows dying over a period of time.

Period	Number of sows dying as a percentage of total sows
1	4.8
2	0
3	10.2
4	26.3
5	10.5
6	7.5
7	6.8
8	7.2
9	12.4
10	0
11	22.1
12	8.2
13	8.6
14	10.0
15	17.4
16	6.8
17	5.9
18	14.9
19	17.3
20	10.7
21	10.4
22	4.2
23	3.8
24	7.6

When they graphed the information into a column graph, it looked like this.



Activity 1

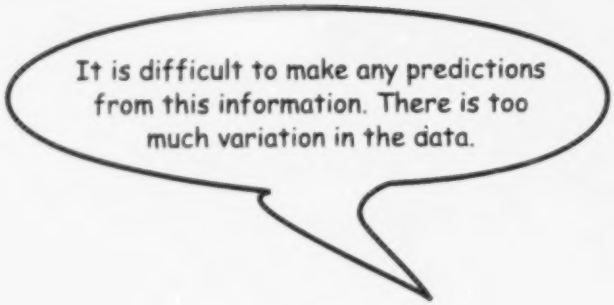
Look closely at the above graph and answer these questions.

1. What is the highest percentage of death in sows?

2. Is there any period were there are no deaths?

3. By looking at the graph, what would you say is the average percentage of deaths?

4. Is it possible to make any predictions about the expected number of deaths from this information?



Moving averages

When the data is as varied as this then it is necessary to recalculate the data. Calculating moving averages will smooth out the fluctuations (wide variations).

This method is used when there is a trend to the fluctuations. For example, the amount of milk sold in a year on a dairy farm fluctuates but also follows a trend. The figures are recorded monthly. There are known peak months and quiet months during the year.

If the data falls into predetermined time-frames, then the moving average is calculated over these time-frames. In the case of dairy production the moving average would be calculated over 12 numbers because there are 12 months in a year. If the data is collected over 4 quarters then the moving average is calculated over 4 numbers and so on.

Activity 2

State the number of figures used in each moving average.

1. Egg production recorded monthly for a year.

2. Utility accounts received quarterly.

3. Monthly interest statements.

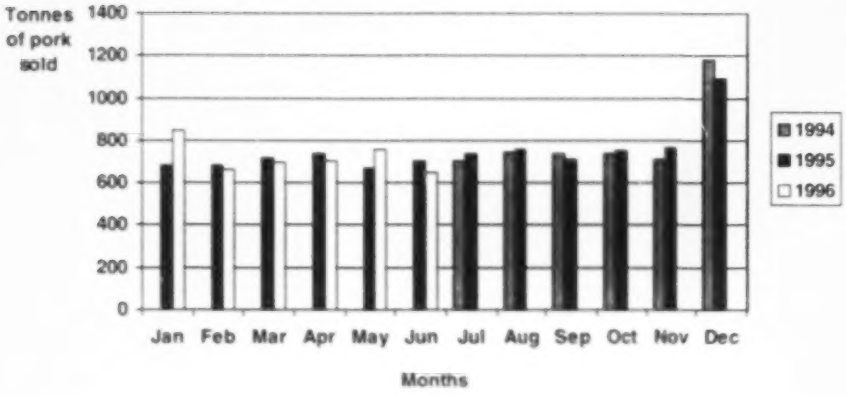
4. Amount of fruit picked daily over a week.

Evaluating data

Following are the figures for tonnes of pork sold to butchers in Victoria.

Month	1994	1995	1996
Jan		685	846
Feb		681	664
Mar		714	700
Apr		735	701
May		669	756
Jun		706	646
Jul	702	737	
Aug	743	755	
Sep	740	708	
Oct	740	752	
Nov	713	767	
Dec	1179	1095	

A graph of this information would look like this:



Activity 3

Look at the above graph and answer the questions.

1. Are there fluctuations in the amount of pork sold to butchers?

2. In which month is the greatest amount of pork sold?

3. Is this true for both years shown?

4. Is there any other trend that you can see?

Calculating the moving average

The previous information shows there are fluctuations that follow a 12-month cycle. To even out these fluctuations a 12-month moving average is calculated.

The following steps are used when calculating the moving average:

Step 1

Calculate the average of the first n numbers and note the average down.

Step 2

Recalculate the average of the next n numbers by deleting the first number and including the n+1 number and record this average.

Step 3

Continue this process of calculating the averages by moving forward one number at a time until all numbers in the information have been used.

Note, there should always be the same number of numbers in the calculation of each average.

To calculate the moving average for the 12-month cycle shown in the previous graph, follow these steps:

Step 1

Calculate the average of the first 12 (in this case n equals 12) months, i.e. July 1994 to June 1995, and write it down.

Step 2

Calculate the average of the next 12 months, i.e. August 1994 to July 1995, and write it down.

Step 3

Continue calculating the averages by moving forward one month at a time until all the numbers in the information have been used.

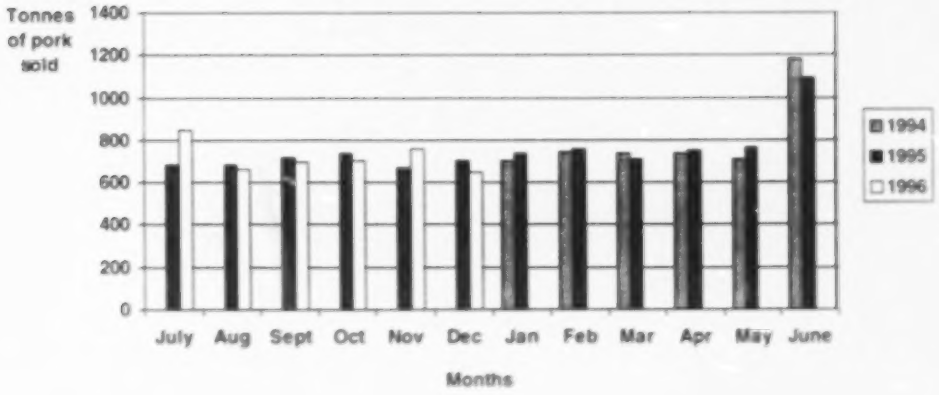
Activity 4

1. The following table has some of the moving averages included in it. Complete the following table.

Month	1994	Moving average	1995	Moving average	1996	Moving average
Jan			685	754	846	
Feb			681	755	664	
Mar			714	752	700	
Apr			735	753	701	
May			669	757	756	
Jun			706	750	646	
Jul	702		737			
Aug	743		755			
Sep	740		708			
Oct	740		752			
Nov	713		767			
Dec	1179	751	1095			

Note: The moving averages have been rounded off to the nearest whole numbers.

2. Plot the moving average (as a line graph) onto the following column graph.



3. How are the figures for the moving averages different from the actual figures?

Moving averages in irregular periods

The previous graph shows how the moving averages even out the fluctuations. In this example the moving average is almost a straight line through about 750 tonnes. This enables the pork wholesalers to see that each month the average required amount of pork for butchers is 750 tonnes. It also shows that the demand has been fairly consistent. There has not been an increase or decline in demand.

From this data it is possible to plan for this tonnage of pork to be available for butchers in the future. Supply would equal demand. The continued plotting of the moving average over a longer period will show any upwards or downwards trend that the recording of the individual data will not highlight.

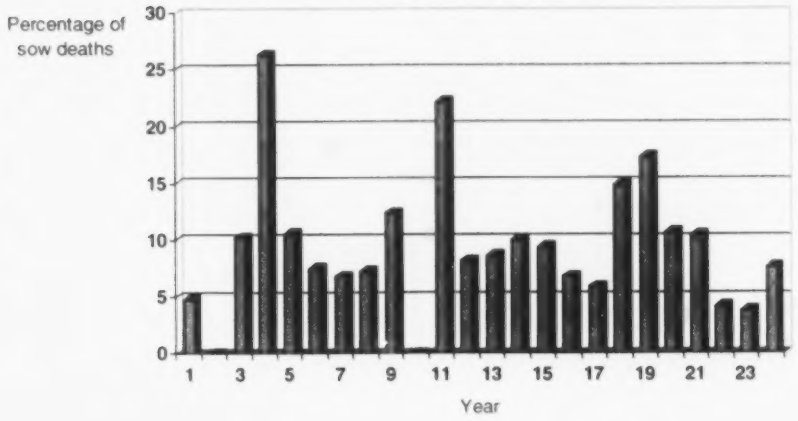
How are moving averages calculated when they do not fall into pre-determined groups such as months or quarters? Let's go back to the original example.

In the following chart, Ian and Joe have recorded the percentage of sows dying over a period of time.

Period	Number of sows dying as a percentage of total sows
1	4.8
2	0
3	10.2
4	26.3
5	10.5
6	7.5
7	6.8
8	7.2
9	12.4
10	0
11	22.1
12	8.2
13	8.6
14	10.0
15	17.4
16	6.8
17	5.9
18	14.9
19	17.3
20	10.7
21	10.4
22	4.2
23	3.8
24	7.6

Note: Running averages have been rounded to one decimal place.

When they graphed the information into a column graph they got a graph like this:



This data has not been collected monthly or quarterly. These are yearly figures. There is no predetermined period for calculating the moving average.

In cases like this, the moving average is calculated over the number of figures between each trough or wave.

In the previous example, there is a high number of deaths in the fourth year and then again in the eleventh year. A further high death rate occurs in the eighteenth year. It appears as if there is a high death rate about every 7 years.

The moving average would be calculated over a 7-year period in this case.

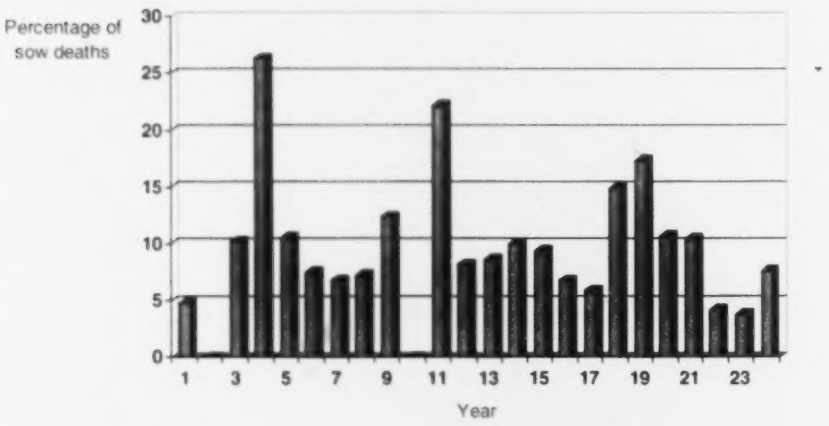
Activity 5

In the following chart Ian and Joe have recorded the percentage of sows dying over a period of time.

1. Using the following data calculate the moving average. The first few have been done for you.

Period	Number of sows dying as a percentage of total sows	Moving average
1	4.8	
2	0	
3	10.2	
4	26.3	9.4
5	10.5	9.8
6	7.5	11.6
7	6.8	
8	7.2	
9	12.4	
10	0	
11	22.1	
12	8.2	
13	8.6	
14	10.0	
15	17.4	
16	6.8	
17	5.9	
18	14.9	
19	17.3	
20	10.7	
21	10.4	
22	4.2	
23	3.8	
24	7.6	

A column graph of the information looks like this:



2. Draw the moving average onto this graph as a line graph. Note that the information shows a 7-year cycle. The first moving average figure you plot for years 1-7 is placed at year 4.

3. From the moving average, what percentage of sows die on average?

4. If Joe and Ian have 80 sows in their herd, how many female piglets should they keep each year to maintain their herd size?

Model answers

Activity 1

1. The highest percentage of deaths in sows is 26.3%.
2. There were no deaths in the second and the tenth period.
3. The average number of deaths looks to be about 8%.
4. There are too many fluctuations to make predictions about the number of deaths.

Activity 2

1. Egg production - 12 figures used in the moving average.
2. Utilities - 4 figures used in the moving average.
3. Interest statements - 12 figures used in the moving average.
4. Amount of fruit picked - 7 figures used in the moving average.

Activity 3

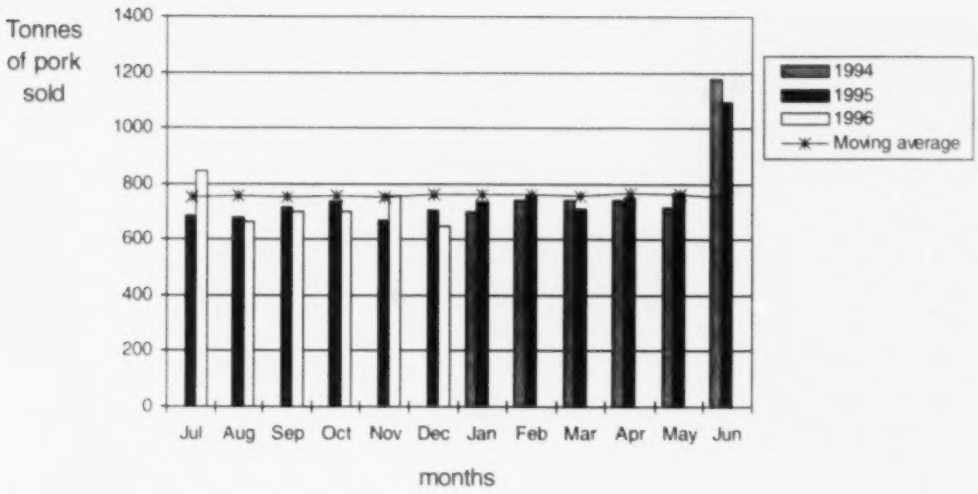
1. Yes, there are fluctuations in the amount of pork sold to butchers.
2. The greatest amount of pork is sold in December.
3. Both 1995 and 1996 show the greatest amount of pork being sold in December.
4. There appears to be no trend other than that pork being sold to butchers remains about the same for the remaining 11 months at about 700 tonnes.

Activity 4

Question 1

Month	1994	Moving average	1995	Moving average	1996	Moving average
Jan			685	754	846	
Feb			681	755	664	
Mar			714	752	700	
Apr			735	753	701	
May			669	757	756	
Jun			706	750	646	
Jul	702		737	764		
Aug	743		755	763		
Sep	740		708	761		
Oct	740		752	758		
Nov	713		767	766		
Dec	1179	751	1095	761		

Question 2



Question 3

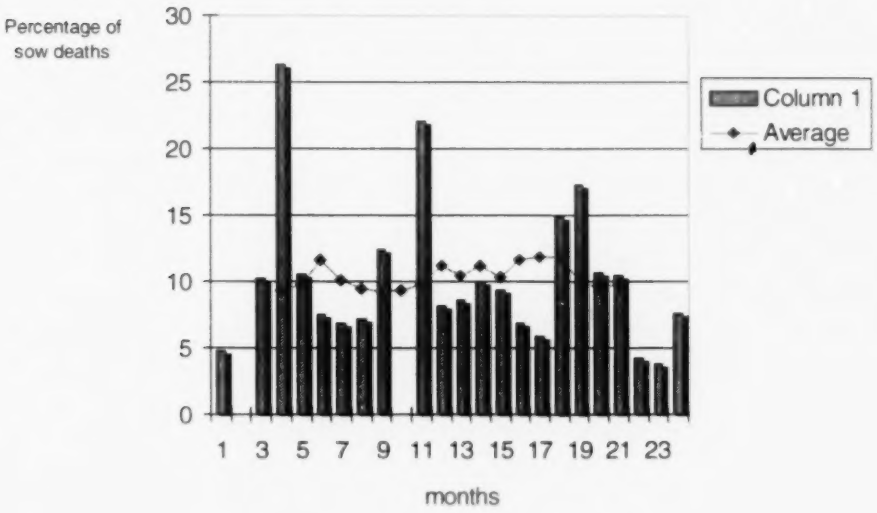
The figures of the moving average are different from the actual figures. The moving average is always around 750 - 760.

Activity 5

Question 1

Period	Number of sows dying as a percentage of total sows	Moving average
1	4.8	
2	0	
3	10.2	
4	26.3	9.4
5	10.5	9.8
6	7.5	11.6
7	6.8	10.1
8	7.2	9.5
9	12.4	9.2
10	0	9.3
11	22.1	9.8
12	8.2	11.2
13	8.6	10.4
14	10.0	11.2
15	17.4	10.3
16	6.8	11.6
17	5.9	11.9
18	14.9	11.9
19	17.3	10.0
20	10.7	9.6
21	10.4	9.8
22	4.2	
23	3.8	
24	7.6	

Question 2



Question 3

The percentage of sows that die on average is about 11%.

Question 4

From the 80 sows, Joe and Ian should keep about 11% or 9 female piglets to maintain their stock levels.